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GB 2254967 A GB 2081638 A WO 92/12320 A1
WO 91/10034 A2 WO 88/02801 A1 US 0001309 H

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INT CL^5 F24F 13/20
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(54) Housing with pultruded frame

(57) An air handling unit comprises a framework of interconnected elongate frame members 10 in the form of pultruded sections in which fibres are embedded in resin. The fibres may run parallel to each other and to the section longitudinal axis. Additional reinforcing fibres may be provided to define connection points for panels 6 which close off the framework. The unit houses dampers, coils, filters or humidifiers for treating air. The pultruded frame members are of hollow box section (Fig 2, not shown). They may be interconnected by moulded corner pieces (Fig 3, not shown).

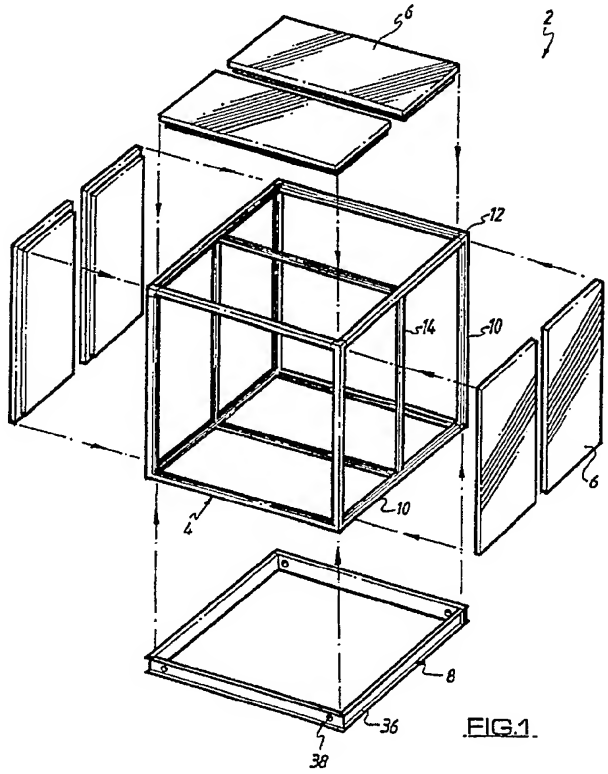

FIG.1

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1990.

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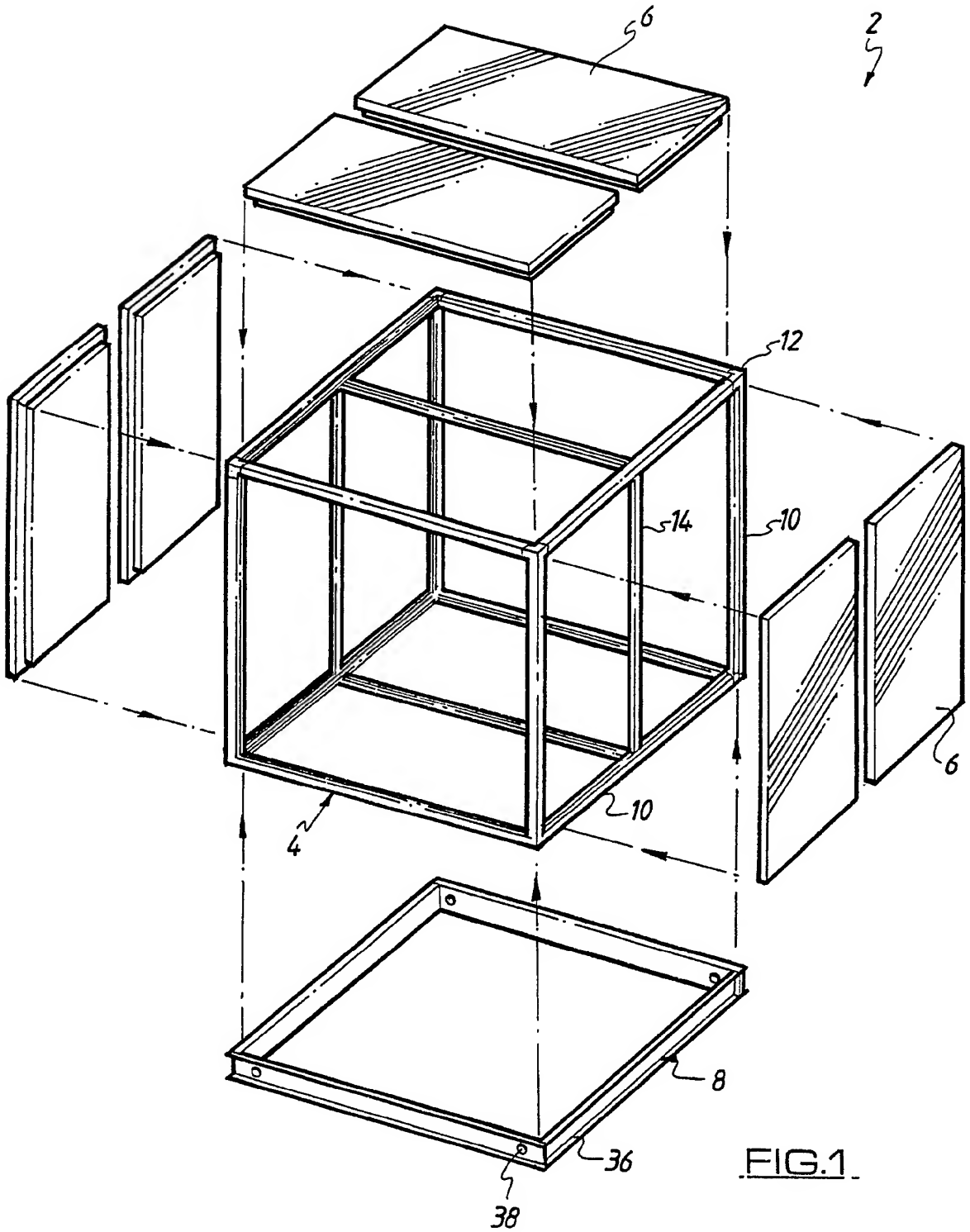


FIG.1

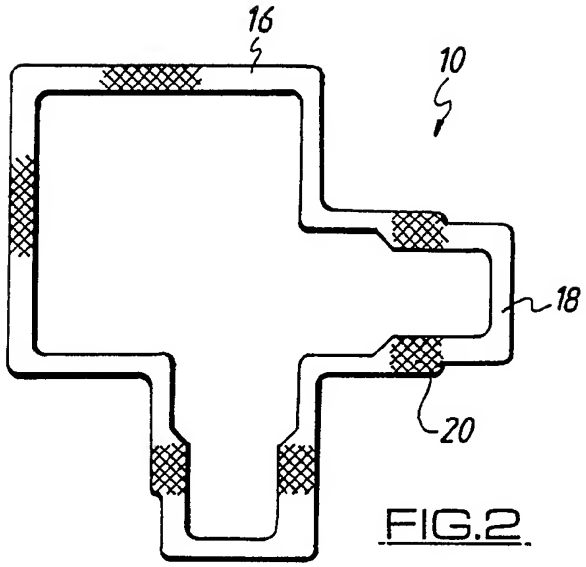


FIG.2

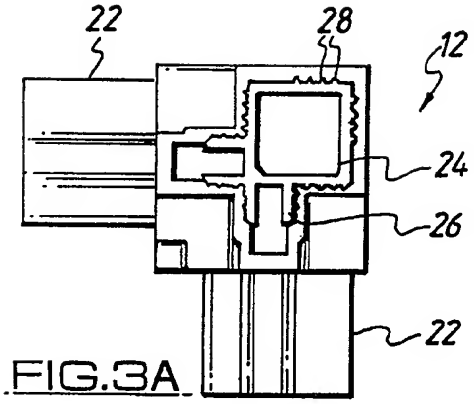


FIG.3A

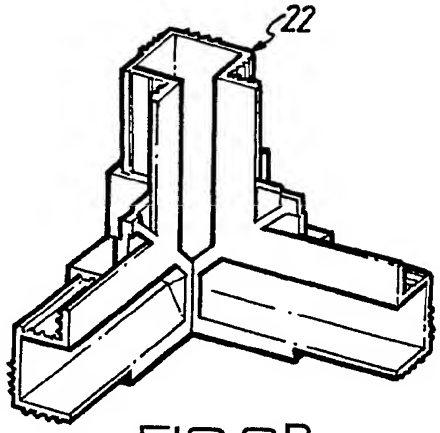


FIG.3B

FIG.3

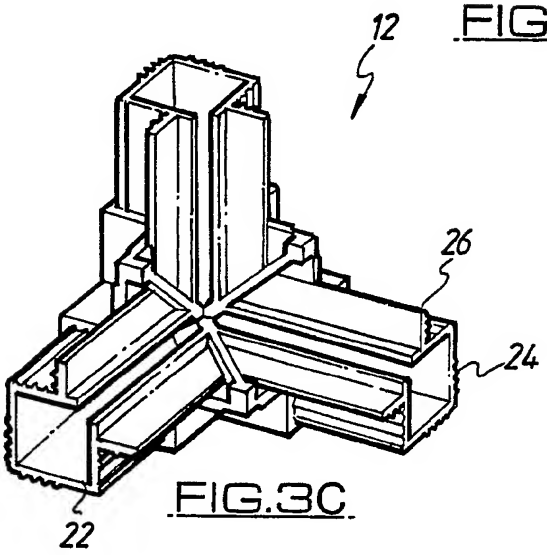


FIG.3C

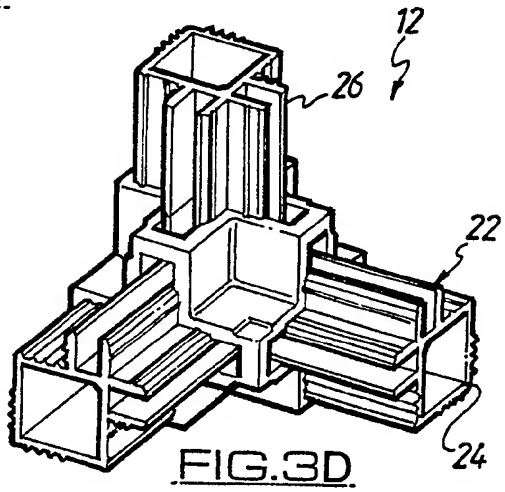


FIG.3D

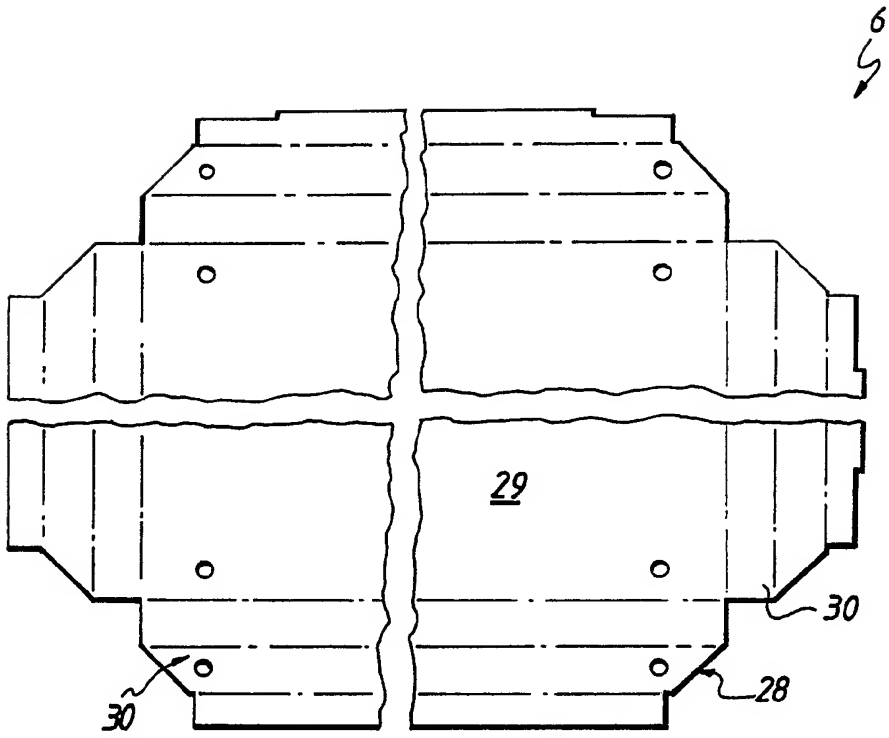
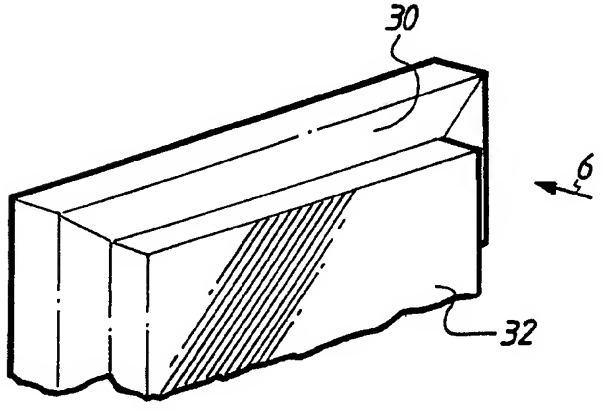


FIG.4



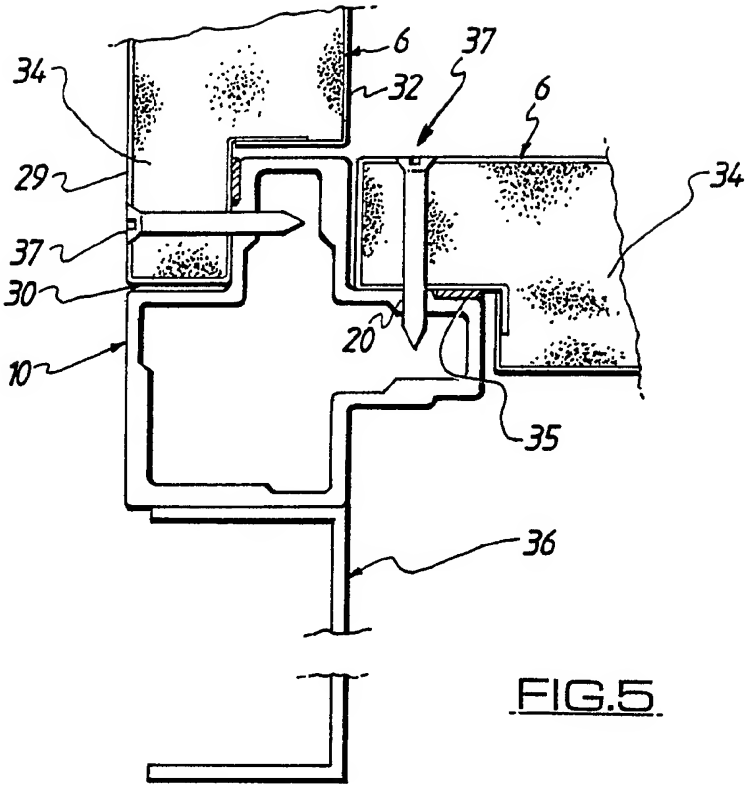


FIG.5

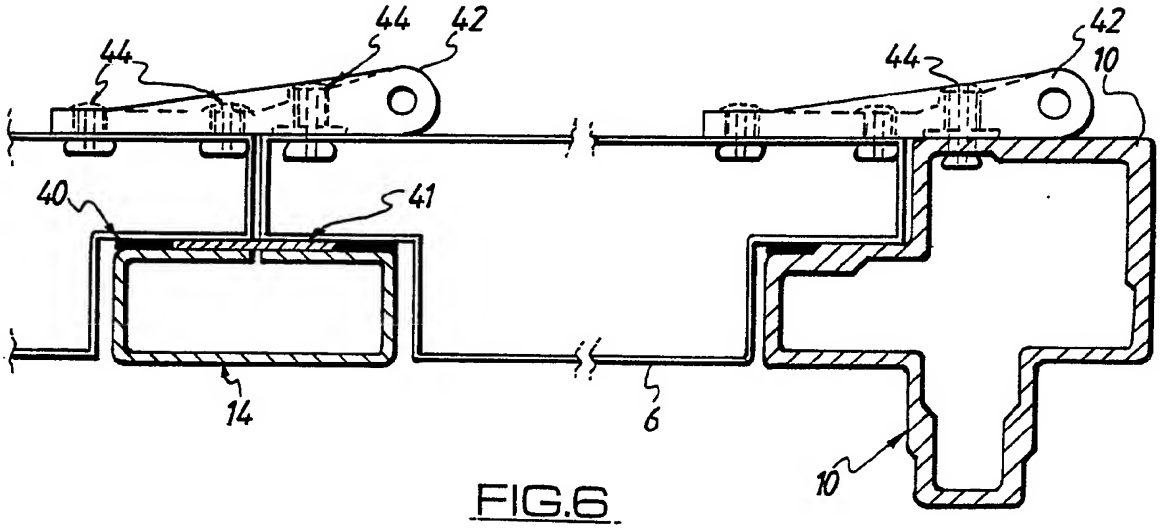


FIG.6

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IMPROVEMENTS IN AND RELATING TO AIR HANDLING UNITS

This invention relates to units comprising a framework and a plurality of panels supported by the framework and, in particular, to such units for use in air handling.

Known air handling units comprise a framework constructed by welding together metallic sections. Panels formed from a hollow metal skin filled with mineral wool or glass fibre are then secured to the frame by screwing or bolting to form a closed unit, with an appropriately positioned air inlet and air outlet. Air handling components such as fans, filters, condenser coils, etc., are then mounted within the thus-formed unit. Ambient air is extracted from the environment, passes through the air inlet, is treated within the unit and then returned to the environment via the air outlet.

Many problems arise with these known units. Firstly, the metallic framework is heat conductive and provides multiple cold bridges given low thermal efficiency and high energy losses. This can also lead to "sweating" under certain climatic conditions. Secondly, the metallic framework is vulnerable to corrosion, particularly if the metal is steel. If it is aluminium, then fire resistance is low. Thirdly, the units are relatively heavy and, therefore, they cannot be stacked nor can elongate units be mounted with their axes vertical.

Further problems which arise with known units are difficulty of cleaning, giving consequent air quality problems, and leakages which allow ingress of unfiltered air and increase energy losses.

It is amongst the objects of this invention to provide a unit useful particularly, but not exclusively, as an air handling unit with which one or more of the above problems is eliminated.

The new unit, as with known units, comprises a framework and a plurality of panels. In a particularly preferred embodiment, the framework is formed from a plurality of elongate frame members, each comprising a

pultruded section. Each elongate frame member is capable of attachment to two mutually transverse panels. Each elongate frame member has a number of reinforced fixing locations to allow attachment of other parts, e.g. panels and intermediate struts thereto. Each elongate frame member may comprise a hollow section including a box section portion with two rectangular portions extending therefrom on either side of a corner of the box section portion. Each frame member may have one or more stepped faces to which a correspondingly stepped panel can be attached so that externally, the frame member and panel attached thereto are flush and provide an essentially continuous outer face, whilst internally, adjacent transverse panels are flush so that no lips are formed and dirt traps are eliminated. With the above described frame member form, the stepped faces may be produced by the rectangular portions.

Pultruded sections are produced by pulling fibres of glass or other materials through a die along with a thermosetting resin. The die has a central hole cut in the shape of the chosen cross section. As the fibres and resin pass through the die, it is heated to set the resin. Suitable resins include polyester epoxy, smokeless acrylic resin and vinyl ester. Fibres may be glass carbon or kevlar. The fibres may lie parallel to each other and to the axis of the section. Additional reinforcement from cross fibres may be provided to define the fixing location(s).

The use of pultruded sections to form the framework is very advantageous as such sections are non-thermally conducting and accordingly cold bridges can be eliminated. An ultra-low energy loss unit can, therefore, be provided which does not sweat in even the most extreme climatic conditions. Pultruded sections are very strong but also very light. For a given size of unit, therefore, section dimensions can be reduced in comparison with those which would be necessary if the sections were metallic. Further,

the units can be stacked and mounted in any desired orientation. Fire and corrosion resistance characteristics are much better than with metallic framework units.

The elongate frame members are suitably connected by use of corner pieces which have three mutually perpendicular fixing arms. The fixing arms are each dimensioned and shaped to be insertable in an end of an elongate frame member and to form a close fit therewith. The corner piece may be attached to the elongate frame members by adhesive and/or by mechanical means such as screws. The corner pieces are suitably formed from a plastics material by injection moulding.

Connectors of the same form as the corner pieces, but including a different number of arms, for example two or four, can be provided to allow building up of the framework.

Alternatively, the elongate frame members may be arranged such that they can be mutually connected to form the framework.

The panels preferably comprise a metallic skin filled with a foamed insulative material by injection. The insulation value of foam insulation can be twice that of mineral wool or glass fibre insulation and thus the panel thicknesses can be reduced compared with known panels. The skin outer surfaces, at least on the face thereof which in use forms the exterior of the unit, are preferably coated with a plastics material such as plastisol. Each panel may have an outer skin and edges formed from steel, suitably from a continuous appropriately preshaped and bent sheet of steel, and an inner face of pre-galvanised steel.

The invention will now be further described by way of example with reference to the accompanying drawings in which:-

Figure 1 is an exploded view of a unit in accordance with the invention;

Figure 2 is a sectional view of a framework member

forming part of the unit of Figure 1;

Figures 3a, 3b, 3c and 3d are respectively a plan and three perspective views of a corner piece forming part of the unit of Figure 1;

Figure 4 is a series of views illustrating the construction of a panel forming part of the unit of Figure 1;

Figure 5 is a section through part of the unit of Figure 1; and

Figure 6 is a section through part of an alternative embodiment of the unit of Figure 1.

The unit 2 shown in Figure 1 comprises a framework 4, panels 6 and a base 8. The framework 4 comprises multiple elongate pultruded sections 10 interconnected by corner pieces 12 and intermediate struts 14.

The form of the elongate frame members 10 is illustrated in Figure 2. As can be seen there, each frame member 10 comprises a box section portion 16 and two rectangular portions 18 extending respectively either side of a corner of the box section portion 16. Each elongate frame member is formed by use of a die with an appropriately shaped hole through which fibres of glass or other materials are pulled along with a thermosetting resin. As the fibres and resin pass through, the die is heated to set the resin. As depicted in Figure 2, additional reinforcing fibres may be provided in the section walls to define fixing locations 20. These fixing locations 20 are capable of receiving screws or bolts.

The use of pultrusion to form the elongate frame members 10 means that these members are light, strong, heat insulative and have good fire and corrosion resistance. In particular, they will not provide cold bridges in the unit 2 and thus render that unit 2 particularly suitable for use as an air handling unit.

The corner pieces 12, which are illustrated in

Figure 3, are formed from a plastics material by injection moulding. Thus the corner pieces 12 will also be heat insulative. Each corner piece 12 includes three mutually perpendicular arms 22. Each arm 22 includes a complete hollow box section portion 24 having a spaced pair of flanges 26 extending from adjacent faces thereof at a corner such that the cross-sectional shape of each arm 22 mirrors that of the elongate frame members 10. The dimensions of the arms 22 are such that an arm 22 can be inserted within an end of a frame member 10 and will form a close fit therewith. The arm 22 and frame member 10 can then be connected by adhesive. Ribs 28 on the arm 22 assist in the formation of an interference fit between the arm 22 and a frame member 10 and further in the mutual adherence thereof. Additionally, or alternatively, an arm 22 can be mechanically fixed to a frame member 10 by, for example, screws. As the majority of adhesives take some time to set, it is generally best in addition to adhesive also to use a screw connection to allow handling of the framework 4, whilst the adhesive is curing.

The cut-away and full perspective views of Figures 3b, 3c and 3d serve to illustrate how the corner piece 12 can be formed by injection moulding.

The top view of Figure 4 illustrates the formation of the outer face and edges of the panels 6. A shaped sheet of steel 28 is bent to form the outer face 29 of each panel 6 and stepped side edges 30. The outer face 29 is coated with a plastics material after bending, for example, plastisol. This gives a tough, yet attractive, surface finish. The panel inner face 32 is formed from a sheet of pre-galvanised steel which is welded to the stepped edges 30 to form a hollow member. Insulative foam 34 is injected into the hollow member which then rigidifies and bonds to the inside faces of the hollow member. The panels 6 are very effective insulators, are strong and rigid and are not easily damaged. The coating on the outer face 29 of the panel 6 makes this face abrasion resistant,

attractive, easy to clean and invulnerable to corrosion.

As noted above, the panels 6 include stepped edges 30. The frame members 10 provide a plurality of stepped faces by virtue of the box shaped portion 16 and rectangular portions 18. The panels 6 can, therefore, be connected to the frame members 10, as illustrated in Figures 5 and 6, so as to define an essentially continuous outer surface to the unit 2 and an inner surface in which adjacent transverse panels are close, giving minimal gaps at the internal corners of the units. The panels 6 sit flush in the framework 4. Gaskets 35 may additionally be employed to reduce even further the chance of air leakage, inwards or outwards, from the unit 2 via the interfaces between the panels 6 and frame members 10.

As illustrated in Figure 5, flush headed screws 37 are preferably employed to connect the panels 6 to the frame members 10. The use of these, together with the flush fitting of the panels 6 and frame members 10 means that dirt traps are eliminated and the units 2 can be thoroughly and quickly cleaned or disinfected by sluicing out so reducing the potential for contamination. It will be noted that the screws 37 do not penetrate through the framework 4 and so do not provide cold bridges.

The strength of the connections between the framework parts and between the framework 4 and the panels 6 is equal to or exceeds that of known units employing welded connections. The units 2 will prevent drumming or distortion of the panels up to a pressure differential of 2,500 Pa.

The base unit 8 comprises a simple frame formed from a plurality of steel sections 36 bolted together, see 38. The base unit 8 is connected to framework 4 by screws in a similar fashion to the connection of the framework 4 to the panels 6.

The intermediate struts 14 may comprise essentially rectangular sections dimensioned to be received at either end in a step of an elongate member 10 whereby they can be

screwed thereto. The connection will be similar to that of the "wall" panel 6 of Figure 5. The width w1 of each intermediate strut 14 is accordingly suitably equal to that w2 of the rectangular portions 18 of each frame member 10. Thus the width w1 will also be approximately equal to that w3 of the step of the panel edges 30. The breadth b1 is suitably approximately twice that b2 of the rectangular portion 18 of each frame member 10 and, therefore, also of that b3 of the step of the panel edges 30. Each intermediate strut 14 will, therefore, be received between two adjacent panels 6 whilst allowing the outer faces of those panels 6 to define an essentially continuous outer surface for the unit 2. The intermediate strut 14 can be adhered or screwed to the panels 6, with gaskets 40 suitably being provided therebetween. If the intermediate struts 14 are formed from a metal then a thermal break 41 is also provided between the struts 14 and the adjacent panels 6. However, preferably the struts 14 also comprise pultruded sections, in which case no thermal break will be required.

Certain of the panels 6 may be hingedly mounted to the framework 4 to provide access doors or openings. The flush fitting means that there are no lips at such doors or access openings which, again, ensures that dirt traps are eliminated.

Figure 6 illustrates the hinged connection of an access panel 6 in the unit 2, the hinge 42 being secured to the panel 6 and to either an adjacent panel 6 or a frame member 10 by pop rivets 44.

The unit 2 is very suitably employed as an air handling unit for the purposes of which dampers, coils, filters, humidifiers, etc. will be mounted within the unit. Its suitability for this use arises from the fact that cold bridges are eliminated and the use of a composite framework 4, insulative panels 6 and insulative connectors 12. Thus the unit as a whole is thermally insulative giving ultra-low energy losses. There is

minimal air leakage via the framework 4 due to the form of the frame members 10 and connectors 12 and between the panels 6 and the framework 4 due to the respective shapes of these parts. The framework is fire and corrosion resistant. It is light, rigid and very strong. The panels are also corrosion resistant and, further, they serve to minimise noise breakout as a result of the insulative foam 34.

The unit 2 could be used for other purposes than as an air handling unit, taking advantage of the properties thereof which include electrical insulativity.

The frame members 10 need not be made by pultrusion although they are suitably formed from a strong insulative material. The connectors 12 may not in all instances be necessary since the frame members 10 could be interconnected simply by screwing together the non-stepped faces thereof. In another alternative, the connectors 12 may have a different number of arms from that illustrated, for example, four or six.

It will be appreciated that the unit 2 is of modular construction and may take different shapes, depending on the number of frame members 10, the shape of the panels 6 and the number and form of the connectors 12. The unit 2 can be readily dismantled into its component parts for replacement or addition thereof.

CLAIMS

1. An air handling unit comprising a framework formed from interconnected elongate frame members wherein the elongate members comprise pultruded sections of resin and fibres.

2. An air handling unit as claimed in Claim 1, wherein the resin is a thermosetting resin which is a good insulator.

3. An air handling unit as claimed in either Claim 1 or Claim 2, wherein, in each section, the fibres lie parallel to the section longitudinal axis and wherein, at locations along the section, additional transversely oriented reinforcing fibres are provided to define connection points.

4. An air handling unit as claimed in any preceding Claim, comprising connectors for interconnecting the frame members including corner pieces for securing three frame members together with their axes mutually orthogonal.

5. An air handling unit as claimed in Claim 4, wherein the connectors are formed from injection moulded plastics material.

6. An air handling unit as claimed in either Claim 4 or Claim 5, wherein the connectors and frame members are secured together by adhesive and/or mechanical fixing means.

7. An air handling unit as claimed in any preceding Claim, further including panels of insulative material for forming, with the framework, an at least partially closed structure.

8. An air handling unit as claimed in Claim 7, wherein the panels are secured to the framework by mechanical fixing means.

9. An air handling unit as claimed in either Claim 7 or Claim 8 when dependent on any one of Claims 4 to 6, wherein the elongate members and connectors are arranged such that recesses are defined in the framework for receipt of the panels therein.

10. An air handling unit as claimed in Claim 9, wherein the recesses are of a predetermined depth such as to control the compression of sealing gaskets fitted to the panels to a predetermined amount.

11. An air handling assembly comprising two or more air handling units as claimed in any preceding Claim connected together to form an enclosure.

12. An air handling assembly as claimed in Claim 11, including air handling components for extracting air from an environment, treating the air in the enclosure and returning it to the environment.

13. An air handling unit substantially as hereinbefore described and illustrated in the accompanying drawings.

14. An air handling assembly substantially as hereinbefore described and illustrated in the accompanying drawings.

Patents Act 1977 Examiner's report to the Comptroller under Section 17 (The Search report) -11-	Application number GB 9313849.3
Relevant Technical Fields (i) UK Cl (Ed.M) F4V (VGBP); F1C (CFE); B5A (AC, AT18P); E1D (ii) Int Cl (Ed.5) F24F 13/20	Search Examiner BRIDIE COLLIER Date of completion of Search 27 OCTOBER 1994
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) ONLINE DATABASES: WPI	Documents considered relevant following a search in respect of Claims :- 1-14

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

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P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	WO 92/12320 A1	(ANDERSEN WINDOWS) see Figure 3 and page 4 line 25 - page 5 line 19	1-14
X	WO 91/10034 A2	(ROKICKI) whole document. "Air handling unit" is the window	1-14
X	WO 88/02801 A1	(ERICSSON) whole document	1-14
X	GB 2254967 A	(MAUNSELL) whole document	1-14
X	GB 2081638 A	(LORD) see Figure 5 and page 1 lines 4-26	1-14
X	US H1309	(US DEPT ENERGY) see page 1 - pump housings, motor housings, heating ducts	1-14

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